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ABSTRACT

In 1998, the Keystone Research Center published a comprehensive review of research on two high-profile ideas for raising educational achievement: lowering class size in the early grades and instituting private school vouchers. This report presents a research update, emphasizing results since early 1998. Over the past 2 years, the evidence on the achievement benefits of lowering class size in grades K-3 has grown stronger. The report discusses the Tennessee Student-Teacher Achievement Ratio program and the Wisconsin Student Achievement Guarantee in Education program. Evidence that private school vouchers raise student achievement remains weak. This report discusses the Milwaukee Parental Choice Program and the Cleveland Scholarship and Tutoring Program--two programs dealing with voucher issues. It also discusses implications of reducing class size for Pennsylvania. (Contains 85 references.) (DFR)

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Smaller Classes and Educational Vouchers: A Research Update

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Smaller Classes and Educational Vouchers: A Research Update

Alex Molnar

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KEYSTONE RESEARCH CENTER

Keystone Research Center

The Keystone Research Center (KRC), a non-partisan think tank with offices in Harrisburg and the Philadelphia area, conducts research on the Pennsylvania economy and civic institutions. This research documents current conditions and seeks to develop innovative policy proposals to expand economic opportunity and ensure that all state residents share in the benefits of economic growth.

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About the Author

Alex Molnar holds a Ph.D. in Urban Education and since 1972 has been a professor in the School of Education at the University of Wisconsin-Milwaukee, where he directs the Center for Education Research, Analysis, and Innovation. Previously, he taught high school social studies in the Chicago area. From 1993-95, Professor Molnar served as chief of staff for the Wisconsin Department of Public Instruction Urban Initiative. He is currently a member of the team conducting the legislatively mandated evaluation of the Wisconsin class-size initiative, the Student Achievement Guarantee in Education (SAGE) program. Professor Molnar has edited, written, or co-authored several books, including *Changing Problem Behavior in Schools* (1989), *Giving Kids the Business* (1996), and *The Construction of Children's Character* (1997). Professor Molnar consults extensively on educational policy and practice issues throughout the United States.

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EXECUTIVE SUMMARY

In January 1998, the Keystone Research Center published a comprehensive review of research on two high-profile ideas for raising educational achievement: lowering class size in the early grades and instituting private school vouchers.[1] In the context of continuing debate about these alternatives, this report presents a research update, emphasizing results since early 1998.

The Achievement Evidence on Smaller K-3 Classes

Over the past two years, the evidence on the achievement benefits of lowering class size in grades K-3 has grown stronger.

The Tennessee Student-Teacher Achievement Ratio (STAR) program. The new evidence on class size includes additional analyses of data from the Tennessee STAR program. Initiated in the mid-1980s, STAR was a genuine scientific experiment. K-3 students in 79 schools were randomly assigned to small classes (about 13-17 students), regular classes (22-25 students), or regular classes with a teacher's aide. As reported in 1998, students in smaller classes achieved significantly higher test scores on average than students in regular classes or regular classes with a teacher's aide. The largest gains were achieved in inner-city small classes.

In the last two years, important new findings have emerged from the Tennessee STAR experiment.

- **The advantages of having attended small classes increased as children reached higher grades.** In grade four, students who attended small classes throughout K-3 were 6-9 months ahead of regular class students in math, reading, and science. By grade eight, these advantages grew to just over one year.

- **Stronger evidence now exists that the benefits of smaller classes are cumulative**. The more years students spent in small classes in K-3, the greater were the long-term achievement benefits.

- **Students who attended small classes in Tennessee took college entrance exams at significantly higher rates than their peers who attended regular-size classes** (Figure 1). In a sample of 9,397 STAR students who were high school seniors in 1997-98, almost 44 percent of those who attended small classes took college entrance exams. This compared to 40 percent of those who attended regular classes. For African-American students, the corresponding figures were 40.2 percent and 31.7 percent respectively. Attending a small class reduced the white-black gap in the share of students who took college entrance tests by 54 percent.

- **More small-class students graduated from high school on schedule**. In a sample of 2,857 STAR students, 72 percent of small-class participants graduated from high school on schedule, compared to 65-66 percent of regular class participants.

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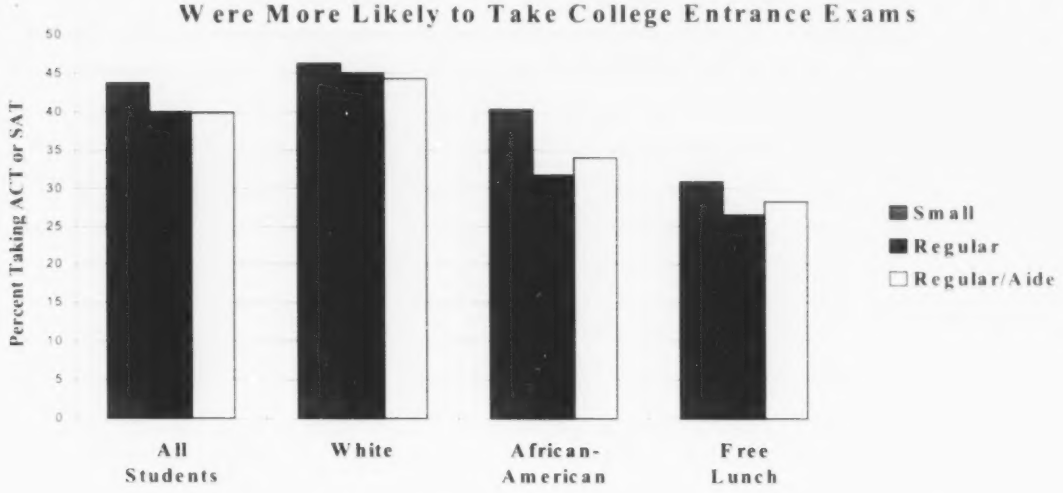
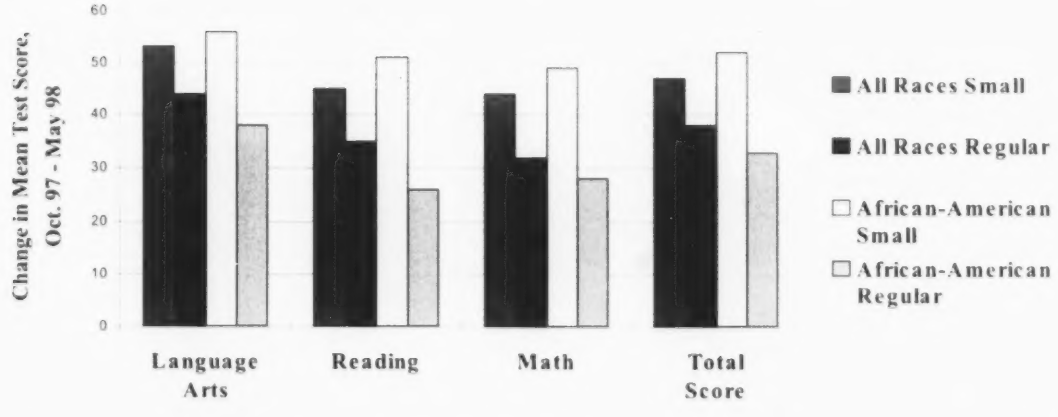
Figure 1.
Tennessee STAR Students Assigned to Small Classes Were More Likely to Take College Entrance Exams



Source: Alan Krueger and Diane Whitmore, "The Effects of Attending a Small Class in the Early Grades on College Attendance Plans," unpublished paper, Princeton University, April 9, 1998.
Notes: Figure shows percent of students who took either the ACT or the SAT exam, by their initial class-size assignment. Sample consists of 9,397 STAR students who were high school seniors in 1998. Free lunch group includes students who ever received free or reduced-price lunch grade K-3.

Figure 2.
Increase in First Grade Test Scores in Wisconsin, Small vs. Regular Classes



Source: Alex Molnar, Philip Smith, and John Zahorik, *1997-98 Evaluation Results of the Student Achievement Guarantee in Education (SAGE) Program* (Milwaukee: School of Education, University of Wisconsin-Milwaukee, December 1998), Tables 17 and 29.

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The Wisconsin Student Achievement Guarantee in Education (SAGE) program. The SAGE program reduced the student-teacher classroom ratio to 15:1 in 30 schools, beginning with kindergarten and first grade in 1996-97 and adding second and third grade in the next two years. The performance of students in SAGE schools has been evaluated against a comparison group of 14-17 schools (the number depending on the year) with similar demographic and socioeconomic characteristics and similar test scores prior to SAGE.

- After two years, the impact of reduced class size in Wisconsin's SAGE program appears to be similar to the impact of smaller classes in Tennessee.

- In both 1996-97 and 1997-98, students in small first-grade classes achieved bigger increases in test scores in language arts, reading, and mathematics (Figure 2). The advantage observed among small first-grade of classes in 1996-97 was maintained in small second-grade classes.

- From fall 1997 to spring 1998, first-grade African-American students in small classes reduced the achievement gap with white students by 19 percent. (In comparison schools, the white-black achievement gap grew 58 percent.)

- In 1997-98, student achievement in SAGE first-grade classes with one teacher and 15 students was not significantly different from achievement in classes with two teachers and 30 students. This suggests that school districts may not need to construct new schools and classrooms to achieve the benefits of smaller classes.

The Achievement Evidence on Educational Vouchers

Evidence that private school vouchers raise student achievement remains weak.

- The Milwaukee Parental Choice Program. No recent results are available from the nation's first taxpayer-financed voucher program because a 1995 legislated expansion eliminated the evaluation requirement. As reported in 1998, conflicting results emerged from three different teams of researchers who analyzed the Milwaukee program based on data from 1990 to 1995.

- The Cleveland Scholarship and Tutoring Program. The official evaluation of the Cleveland voucher program, the nation's second publicly financed voucher program, found no significant difference between third-grade voucher students and public school students in 1996-97. A second research team re-examined these data and found gains for voucher students in language and science but not reading, math, and social studies. These positive findings hinge on two controversial methodological choices, including the use of a lower than conventional threshold for statistically significant results.

- In 1997-98, the official evaluation found that fourth-grade Cleveland voucher students achieved better than their public school counterparts in language, but not significantly differently in four other subjects, including reading and math, if statistical controls are included for class size, teacher experience, and teacher's educational background.

- The evaluation of the Cleveland program in 1997-98 also found that student performance in *new* private schools is significantly *worse* than student performance in public schools.

Private voucher programs. Several new private voucher programs have been established in recent years. A New York voucher program has generated fragile evidence of positive effects of vouchers for older students in elementary school. Several other private voucher programs are conducting evaluations that will produce results in the next several years.

A general problem with small-scale voucher experiments is that they tell us little about the impact of large-scale programs. When small numbers of low-income students are placed in established private schools, these students often benefit from "peer effects." That is, they benefit from attending school with students who come from relatively more affluent families, have relatively more educated parents, or have parents who are more actively involved in their education.

In larger-scale experiments, new private schools must be established and existing ones substantially expanded. Peer effects may be similar to those in public schools. Differing peer effects may explain why voucher students in new private schools in Cleveland performed worse than students in public schools, while voucher students in established private schools performed better.

Implications for Pennsylvania

As the results of the Tennessee class-size experiments and the Wisconsin SAGE evaluation have become more widely known, reducing class size has become a favorite of state and federal legislators, as well as parents, across the country. In California, smaller classes have been introduced so rapidly and on so a large scale that the achievement benefits and the cost-effectiveness of the reform may be reduced.

Pennsylvania has a rare opportunity to introduce a class-size reduction program targeted on the areas in which it would generate the greatest benefits and designed scientifically to generate knowledge of how to improve educational achievement in a cost-effective manner. Such a **SMART (Scientific Methods, Achieving Results Today) class-size** program should begin by reducing class size in kindergarten and first grade. As in Wisconsin, priority should be placed on lowering class size in schools that serve high proportions of low-income students. Smaller classes should be introduced in the rest of the state on an experimental basis, as should smaller classes in second and third grade. Building on Wisconsin's experience, Pennsylvania should evaluate the benefits of combining class-size reductions with other (e.g., curricular and teacher training) innovations.

As SMART class-size program students progress through higher grades, Pennsylvania should track social indicators of well-being as well as achievement test scores. In Wisconsin,

the interest in smaller classes that led to the SAGE program stemmed from their potential social as well as achievement benefits. A statewide Urban Initiative task force (which included bipartisan legislative and business leaders) believed that smaller K-3 classes might reduce youth violence by increasing the chance that children entering school would find an adult who knows and cares for them.

The Tennessee STAR experiment represents not just a shining example of scientific educational research but also an inspiring illustration of bipartisan politics at its best. STAR was the result of a compromise between legislators who wanted widespread class-size reductions and those who considered them too expensive given the quality of the evidence on their benefits.

Pennsylvania now has a chance to achieve a similarly historic advance. It can invest in high-payoff class-size reduction for low-income students while conducting systematic analysis of what additional investments would make the most sense. A dozen years from now, a SMART class-size program could win for Pennsylvania the kind of recognition now accorded the Tennessee STAR experiment.

Voucher and Class Size Resources on the World Wide Web

Vouchers

Milwaukee Parental Choice Program: http://www.dpi.state.wi.us/dfm/sms/choice.html
Information about the Milwaukee Parental Choice Program can be found on the Wisconsin DPI homepage.

Program on Educational Policy and Governance: http://data.fas.harvard.edu/pepg/
Voucher program evaluations by Professor Paul Peterson and co-authors can be found by following the "Papers" link.

Partners Advancing Values in Education (PAVE): http://www.pave.org
Homepage of the PAVE program. For other information on PAVE, see http://www.ceoamerica.org/info/Milwaukee.html.

Indiana Center for Evaluation: http://www.indiana.edu/~iuice/
Homepage of the Center that conducted the state-funded evaluation of the Cleveland Scholarship and Tutoring Program.

***School Choice 1999: What's Happening in the States*, by Nina Shokraii Rees and Sarah E. Youssef:**
http://www.heritage.org/schools/
An annual state-by-state report on voucher and charter school developments found on the Heritage Foundation homepage.

Parents Advancing Choice in Education (PACE): http://www.ceoamerica.org/info/Dayton.html
An information page about PACE, the privately funded Dayton, Ohio, voucher program.

Educational Choice Charitable Trust: http://www.ceoamerica.org/info/Indianapolis.html
An information page about Indianapolis' privately funded voucher program.

Washington Scholarship Fund: http://www.wsf-dc.org
The homepage of the privately funded voucher program in the District of Columbia.

CEO America: http://www.ceoamerica.org
Homepage of CEO America, an umbrella group that supports privately funded voucher programs around the country.

CEO Horizon-Edgewood Program: http://www.ceoamerica.org/horizon-news.html
Information about CEO America's Horizon-Edgewood voucher program in San Antonio, Texas.

Mathematica Policy Research, Incorporated: www.mathmatica-mpr.com
The website of Mathematica, a company that evaluates voucher programs, including the New York program.

Class Size

"The Evidence on Class Size," Eric A. Hanushek: http://www.edexcellence.net/library/size.html
Hanushek's 1998 analysis of the various class-size reduction programs around the country.

Student Achievement Guarantee in Education Evaluation Project: http://www.uwm.edu/SOE/centersprojects/sage/
The website of the evaluation of Wisconsin's class-size reduction program.

HEROS (Health and Education Research Operative Services, Inc.): http://www.telalink.net/~heros
The HEROS site includes links to many studies and commentaries on the Tennessee STAR class-size reduction program.

California Class Size Reduction Program: http://www.cde.ca.gov/ftpbranch/sfpdiv/classize/
The website for California's CSR program, on the California Department of Education homepage.

WestEd: http://www.wested.org/
WestEd is the regional research laboratory serving Arizona, California, Nevada, and Utah. See http://www.wested.org/policy/pubs/full_text/class_size/ for WestEd's 1998 evaluation of California's class-size reduction.

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A NEW BOOK BY THE STAFF OF THE KEYSTONE RESEARCH CENTER

Three-quarters of the American workforce is now employed in services, a substantial portion in low-paying, dead-end jobs. Can the service economy do as well by the American worker as the manufacturing economy once did? Can the widely shared prosperity that accompanied steady increases in productivity and performance in manufacturing be replicated in the services? They can and they will, the authors of this timely book contend, but only if outmoded policies and practices are brought into line with the new economy. *New Rules for a New Economy* explains why this goal must be accomplished and how we can start.

The authors call for new, decentralized institutions suited to a dynamic economy in which change is constant and rapid. In particular, they see a need for job ladders and worker associations that cut across firm boundaries. These institutions would foster individual and collective learning, mark out career paths, and facilitate coordination among both individuals and organizations in a networked economy. The authors propose new rules to reshape labor market institutions and policy, improving economic performance and opportunities for workers.

REVIEWERS' PRAISE FOR *NEW RULES FOR A NEW ECONOMY*

"A stimulating book."

- *Financial Times* of London

"A challenge to liberals by fellow liberals to rethink their traditional economic policies."

- *The New Democrat*

"If you want to know why wages are stagnant and social inequality is growing, this book is the place to start. And... the authors propose the kinds of reforms – simultaneously practical and radical – necessary to bring about change."

- Nelson Lichtenstein, University of Virginia

"This book should serve as a springboard for a serious public debate of what it would take to reverse rising inequality and make America's economy deliver again for more than a small minority."

- Richard Leone, Twentieth Century Fund

"A stellar achievement that breaks new ground."

- Harley Shaiken, University of California, Berkeley

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INTRODUCTION

In January 1998, the Keystone Research Center published *Smaller Classes - Not Vouchers - Increase Student Achievement*, a comprehensive synthesis of research on the achievement consequences of instituting private school vouchers and of reducing class size in the early grades. Nationally and in Pennsylvania, vouchers and smaller classes have remained the focus of intense interest during the past 15 months. Important new research findings have been published on the effect of vouchers and smaller classes. For policymakers and the general public, this update summarizes the latest evidence, placing it in the context of key findings from earlier research. Although this report is self-contained, readers interested in comprehensive evaluations of earlier research may wish to read this document in combination with the earlier Keystone report.

What Are These Researchers Talking About? A Glossary of Terms

CSTP: The Cleveland Scholarship and Tutoring Program, the official name of the Cleveland voucher program.

Control (as in "control for" and "control group"): To evaluate the impact of a voucher program or smaller class size on student achievement, analysts need to isolate their impacts from those of other variables (such as a students' family background). This can be done by comparing the performance of the students who get vouchers or attend small classes with the performance of another group of students—a "control group"—that is as similar as possible except for not having received vouchers or attended a small class. In statistical analysis, researchers usually take explicit account of—or "control for"—family and individual difference, so that the impact of vouchers or class size will not be incorrectly estimated.

Effect size: To evaluate the benefits of vouchers or smaller class sizes, you need to know how big an impact they have on student achievement. Effect sizes gauge this impact by looking at the gap in test scores between students who receive vouchers or attend small classes and students who don't. This gap is divided by a measure of the overall spread of student scores. (See standard deviation.)

Meta-analysis: When a large number of studies has been conducted on a subject—such as the achievement impact of small classes—a systematic evaluation, or meta-analysis, of these prior studies may be used as a tool for determining the overall weight of the evidence. In weighing the importance of each study, the meta-analysis takes into account such factors as its sample size and the quality of the research methods used.

MPCP: Milwaukee Parental Choice Program, the official name of the Milwaukee voucher program.

Percentile ranks: To evaluate the benefits of vouchers or smaller class sizes, you need to know how big an impact they have on student achievement. One way to do this is to consider how much an improvement in test scores would move a student up in the overall student ranking. If an improvement would move a student up from, say, the mid-point of the achievement curve (the 50th percentile) past another 10 percent of students (to the 60th percentile), it would be said to have improved scores by 10 percentile ranks.

Standard deviation: a measure of how spread-out a group of numbers (such as student test scores) is. It equals the square root of the average squared difference between each test score and the average test score.

Statistical significance: In evaluating the impact of vouchers or class size on test scores (or of any variable on another variable), researchers want to know whether they can be confident that an observed performance difference is large enough that it could not have occurred by random chance. If the difference is so large that it could only have occurred by chance with a small probability ("small" being defined customarily as 5 times out of 100), then the observed change in performance is considered to be statistically significant.

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EDUCATIONAL VOUCHERS: A RESEARCH UPDATE

The Argument Over Vouchers

Proponents of vouchers tend to base their position on three widely held beliefs about public education:

1. that educational outcomes have deteriorated,
2. that American public education costs have accelerated unreasonably, and
3. that the public schools cannot reform themselves because of bureaucratic and political constraints.

Each of these beliefs is subject to serious challenge. There is considerable evidence that educational outcomes have actually improved over the last 20 years. A 1993 report written by scientists at the Sandia National Laboratories found that U.S. public education performance was improving.[2] Between the 1970s and 1990, according to a 1994 RAND study, reading and math scores rose significantly for Hispanics and African-Americans.[3] In a March 1998 article, Princeton University economist Alan Krueger reported that National Assessment of Education Progress (NAEP) exams reveal rising American public school performance over the past 20 years.[4] For example, a student scoring in the 50th percentile today performs as well as the 56th-percentile student 25 years ago.[5] The most disadvantaged students have made the greatest gains. Moreover, between the early 1970s and 1990, the black-white NAEP test-score gap for 17-year-olds decreased by almost half (before increasing slightly in the 1990s).[6]

Contrary to the second widely held perception driving support for vouchers, Richard Rothstein found that resources for regular classrooms at public schools have increased only modestly over the last several decades.[7] Rothstein reached this conclusion by identifying expenditures on special education, transportation, and other activities outside the regular classroom. In a survey of nine school districts, he found that inflation-adjusted per-pupil spending for regular education rose by only 28 percent from 1967 to 1991. In Los Angeles, inflation-adjusted per-pupil spending on regular education *declined* by 3.5 percent over the same period. If this decline in spending for regular education typifies developments in urban areas, it may help explain worsening relative academic outcomes in some urban public schools. Rothstein's research also suggests that carefully targeted increases in spending on regular classroom instruction in urban areas may increase both parental satisfaction and student achievement.

Of course, national statistics about gradually improving performance and the stagnation of funds flowing to regular classrooms in urban school districts are of little comfort to parents convinced that their own children will not get the lift they need from the local public school.

Parents who want better schools for their kids **now** have been a receptive audience for the third widely held belief that underlies support for vouchers today: that public schools are incapable of reforming themselves because of bureaucratic and political constraints. This argument gained intellectual legitimacy with the 1990 publication of *Politics, Markets, and America's Schools* by John Chubb and Terry Moe.[8] In their book, Chubb and Moe argued that private school vouchers are needed

because private schools exhibit superior academic performance and because public school performance has not improved despite reforms instituted during the 1980's.[9]

Chubb and Moe's claims notwithstanding, the research literature contains no clear evidence that private schools are better than public schools. Moreover, since most of the studies in the literature on public versus private schools use data for secondary schools, they are of limited value in predicting the impact of voucher programs that, for the most part, involve private elementary schools.[10]

Many proponents of private school vouchers, such as Wisconsin Assembly member Annette "Polly" Williams, author of the Milwaukee Parental Choice Program legislation, link vouchers to their desire to empower poor families and raise the academic achievement of poor children. They argue that vouchers may improve achievement by forcing the public schools to compete in an educational marketplace in which poor parents hold the power of the purse. What does the research evidence show?

The Milwaukee Parental Choice Voucher Program

Private school vouchers have been debated at the state level for over 20 years. However, voucher legislation has become law in only three states, Wisconsin (1990), Ohio (1995), and now Florida (1999).

Wisconsin established the country's first publicly funded private school voucher program in Milwaukee. Today, the Milwaukee Parental Choice Program (MPCP) is the voucher program for which the greatest volume of systematic data is available.

The MPCP initially allowed up to 1 percent of low-income Milwaukee Public School students (about 1,000 students) to attend participating private, non-sectarian schools within the city (Table 1). The program defined "low-income" as below 175 percent of the official U.S. poverty line. Each child attending a private school in the program receives a voucher worth the per-pupil equalized state aid to the Milwaukee Public Schools, originally set at $2,446 and currently $4,894 (in 1998-99). The Wisconsin legislation that created Milwaukee's Choice program provided for yearly evaluations of the academic achievement of students attending Choice schools.

In 1993, the Milwaukee Parental Choice Program was modified to raise (effective 1994-95) the number of students who could participate from 1 percent to 1.5 percent of the Milwaukee Public School population (i.e., to about 1,500 students). A 1995 change allowed religious schools to participate in the MPCP and raised the eligibility ceiling to 7 percent of the Milwaukee Public School enrollment in 1995-96 and 15 percent in 1996-97.

The 1995 revision of the MPCP, deemed constitutional by the Wisconsin Supreme Court on June 10, 1998, does *not* require that the schools participating in the program gather the achievement data necessary for a comprehensive evaluation. Because the necessary data are unavailable, no evaluation of the achievement impact of the program since 1995 has been conducted. Although the Wisconsin Legislative Audit Bureau is required to issue a report in the year 2000, no meaningful evaluation of the achievement impact of the program since 1995 is likely in the future.

Table 1.
Milwaukee Parental Choice Program Profile 1990-99

School Year	Number of Schools	Number of Applicants	Average Number of Voucher Students*	Voucher Amount	Total Cost of Vouchers (millions of dollars)	Annual Attrition Rate (percent)
1990-1991	7	577	300	$2,446	$0.73	46 %
1991-1992	6	689	512	$2,643	$1.35	35 %
1992-1993	11	998	594	$2,745	$1.63	31 %
1993-1994	12	1049	704	$2,985	$2.10	27 %
1994-1995	12	1046	771	$3,209	$2.47	28 %
1995-1996	17	--	1288	$3,667	$4.61	--
1996-1997	20	--	1616	$4,373	$7.07	--
1997-1998	23	--	1497	$4,696	$7.03	--
1998-1999	88‡	--	5806**	$4,894	$28.41**	--

-- Information not available.
*Calculated as the average of September and January memberships, plus summer school membership.
**Estimate.
‡There are three schools within one organization, Seeds of Health.
Sources: State of Wisconsin Department of Public Instruction web page, http://www.dpi.state.wi.us/dpi/dfm/sms/histmem.html; John F. Witte, Troy D. Sterr, and Christopher A. Thorn, *Fifth-Year Report: Milwaukee Parental Choice Program* (Madison, WI: Robert M. La Follette

The Achievement Effects of The Milwaukee Voucher Program

The 1998 Keystone report contained an extended discussion, summarized only briefly below, of the findings of research on the Milwaukee voucher program.[11] Since the release of that report, no new research has been published on the program (although the head of the official evaluation team, John Witte, did publish a new synthesis of his prior work).[12]

In considering the Milwaukee voucher program's achievement effects, four features should be kept in mind that make the program difficult to evaluate.

1. During each of the evaluation years (1990-95), the program enrolled less than 800 students (Table 1).

2. The parents of the 300-800 students in the program during the evaluation years had more education and higher academic expectations than the parents of most of the other 60,000 eligible Milwaukee Public School students. It is possible that students of parents with more education and higher expectations would achieve faster whether in public schools or voucher schools.

3. More than 80 percent of Milwaukee voucher students in the evaluation years attended three schools with established reputations. At best, the Milwaukee voucher experiment tells us something about how these particular private schools compare with the Milwaukee public schools as a group. It indicates nothing about the impact of a larger-scale voucher program in which some students attend new private schools.

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Keeping these program characteristics in mind, the following conclusions about the achievement consequences of the MPCP can be drawn from the results of the three research teams that analyzed the Milwaukee data.

1. Disagreement exists about whether the voucher program generates positive achievement outcomes compared to the Milwaukee Public School system. Two of three research teams, including the methodologically most sophisticated (Cecilia Rouse of Princeton University), found no positive outcomes for the voucher students in reading. Two of three research teams, including Rouse, found positive outcomes for voucher students in math.

2. Rouse found that a group of Milwaukee public schools that have small classes and serve low-income students perform as well as voucher schools in math and better than voucher schools in reading. Rouse also discovered that voucher schools appear to have smaller classes than any of three sub-groups of Milwaukee public schools. Thus, any achievement benefit of voucher schools compared to the Milwaukee Public School system overall may be a result of smaller classes rather than any inherent advantage of private over public schools.

Rouse's final word on the Milwaukee voucher program is:

> If we really want to "fix" our educational system, we need a better understanding of what makes a school successful, and we should not simply assume that market forces explain sectoral [i.e., public-private] differences and are therefore the magic solution for public education.[13]

The Cleveland Scholarship and Tutoring Program (CSTP)

Ohio enacted the Cleveland Scholarship and Tutoring Program (CSTP) legislation in March 1995 (Table 2 profiles the program).[14] The CSTP legislation allowed the Ohio Superintendent of Public Instruction to create a pilot voucher program in Cleveland. The Cleveland program is largely supported by money from Ohio's Disadvantaged Pupil Impact Aid Program, previously earmarked for the Cleveland Public Schools.

Scholarship recipients are selected by lottery with priority going to applicants whose family income is less than the Federal poverty level. Second priority goes to families whose income is less than twice the poverty level. There is no income cap on participation.

The approximately 30,000 K-3 students who reside within the Cleveland School District are eligible to apply to the program. Once admitted to the program, students may receive scholarships through eighth grade

Since the Cleveland voucher program allows religious schools to participate, its constitutionality was immediately challenged. On July 31, 1996, the Franklin County Court of Common Pleas held the program constitutional and allowed it to be implemented. On May 1, 1997, an Ohio appeals court ruled the program unconstitutional. The Ohio Supreme Court allowed the program to go forward while it considers an appeal. It has not yet issued a ruling.

Table 2.
Cleveland Scholarship and Tutoring Program Profile
1996-99

School Year	Number of Schools	Number of Applications	Number of Voucher Students	Average Value of Voucher	Total Cost of Vouchers (millions)	Annual Attrition Rate
1996-1997	56	6,244	1,994	$1,750	$3.18	17%
1997-1998	57	6,811	1,289	$1,776	$4.74	14%
1998-1999	60	4,429	1,320	--	--	--

-- Information not available.
*Includes figures only for the voucher component of the program, not the tutoring component.
**As of June for each school year.
Source: Ohio Department of Education.

On June 24, 1997, Professor Paul Peterson of Harvard issued a press release that some observers interpreted to mean that his research team was conducting the official evaluation of the Cleveland program. In fact, his study was privately funded, not commissioned by the Ohio Department of Education.

Three months later, in September, Peterson and co-authors Jay Greene and William Howell (PGH) released a report that analyzed test scores from two private schools, Hope Central Academy and Hope Ohio City Academy. The achievement results were expressed as percentile-rank changes on fall (1996)-to-spring (1997) testing. PGH report overall K-3 percentile-rank changes of +5.6 (reading), -4.5 (language), +11.6 (math total), and +12.8 (math concepts). Most schools, however, gain every spring and fall back the next autumn. Indeed, as PGH report in a subsequent paper, by fall 1997 no significant gains for Hope students were observed in math concepts and no gains were observed in language. (Significant gains were still observed in total math and reading scores.[15])

More important, for changes in test scores to be meaningful, a carefully chosen comparison group must also be tested. The September 1997 PGH analysis had no such comparison group. Instead, it made a comparison to low-income Milwaukee voucher applicants whose results were not from the same test used by the Hope schools. The September 1997 PGH evaluation is so flawed that it contributes little if anything to an understanding of how voucher programs might affect student achievement.

Official Evaluation Results for Cleveland Scholarship and Tutoring Program

The legislatively mandated independent evaluation of the Cleveland Scholarship and Tutoring Program is being conducted by an Indiana University research team headed by Professor Kim Metcalf. This team published reports on the program's first year (1996-97) in March 1998 and second year (1997-98) in November 1998.[16]

To evaluate the Cleveland voucher program, Metcalf's team compared the test scores of third-grade voucher recipients with those of Cleveland Public School students, controlling for prior test scores and family characteristics. In 1996-97, the Metcalf evaluation examined third grade performance because that was the lowest grade for which usable test data (from second grade) existed to measure student ability prior to the voucher experiment.

The first-year official evaluation report found that, after controlling for background characteristics, third-graders participating in the voucher program in 1996-97 did not achieve at a higher level (on reading, language, mathematics, science, and social studies tests) than students who remained in the Cleveland Public Schools. The second-year report (1997-98) found that fourth-grade students in the voucher program achieved significantly better than their public school counterparts in science and language. When classroom variables (e.g., class size, teacher experience, and teacher level of education) are accounted for, the voucher students achieved significantly higher scores only in language.

The Peterson team criticized the Metcalf team's first-year report for several reasons.[17] PGH argued against the use of second grade test data as a control for student performance prior to the voucher program on the grounds that these test results "lack plausibility." PGH deemed these test scores implausible because the scores showed low-income, largely single-parent families performing close to the national average in the second grade and then scoring at substantially lower levels the next year. PGH also maintained that the second-grade test scores have implausibly weak correlations with family background characteristics. Leaving out the second-grade test scores, however, means that any comparison of voucher student achievement with that of public school students takes no account of differences in student performance prior to the program. Moreover, if the second-grade test scores were uniformly inflated for both voucher students and those who remained in the Cleveland Public Schools (e.g., because second-grade public schools "teach to the test"), they would still be a good control measure.

PGH also maintained that the Metcalf evaluation team should have included student scores from the Hope schools, since 25 percent of voucher students went to these newly created schools. Metcalf's team had excluded the Hope schools because their students took a different test than the public school students and students at other voucher schools. An additional problem with including Hope students is that approximately 58 of the 155 Hope students tested in the spring of 1996 appear not to have been tested in the fall of 1997, an unusually high attrition rate. Without information on the characteristics of these students it cannot be known what impact their absence may have had on the results reported.

When PGH reanalyzed the official data excluding the second-grade test scores and including the Hope students with converted scores, they found that voucher students scored significantly higher in language and science, but not significantly higher in math, reading, or social studies. When the second-grade test scores were included, the Peterson team found results consistent with those of the

official evaluation team: voucher students did not score significantly higher than their public school counterparts at conventional levels of statistical significance. Using a lower statistical significance threshold than conventional (the .10 level, a 10 percent chance that the results could have occurred by chance), PGH found that voucher students did better in language and science, but not in reading, math, and social studies.

The second-year (1997-98) Metcalf team evaluation also found that not all schools participating in the voucher program had similar achievement results. Students attending established private schools were responsible for the voucher student achievement advantage in science and language. Students in the newly established private Hope schools scored significantly lower than their public school counterparts in all tested areas.

The finding that student performance in the new voucher schools is significantly worse than student performance in public schools raises serious questions about the viability of voucher programs as a large-scale education reform. Existing private schools may produce benefits for low-income students by placing them with a majority of students from more privileged or more academically oriented backgrounds. The adoption of large-scale voucher programs may, however, alter the social context that produces whatever achievement benefit there may be for low-income minority students in attending private schools.[18]

Private Voucher Programs

Voucher programs supported by private sources provide another potential source of information on the educational consequences of vouchers. In 1998-99 there were 41 privately funded voucher programs in the United States, according to Troy Williamson of the CEO America Foundation (interview, March 29, 1999). There have been few systematic efforts to study the impact these programs are having on student achievement. This section describes those programs for which achievement data exist or for which an evaluation plan that will provide achievement information has been adopted.

Milwaukee: Partners Advancing Values In Education (PAVE)

Perhaps the country's largest private program operates in Milwaukee. Partners Advancing Values in Education (PAVE) - formerly the Milwaukee Archdiocesan Education Foundation - was founded in 1992. PAVE provides low-income families with scholarships worth half of the tuition charged by a private religious or non-sectarian school up to a maximum of $1,000 for elementary and middle school students and $1,500 for high school students. PAVE's major donors include the Lynde and Harry Bradley Foundation, TREK Corporation, CEO America, Johnson Controls, Northwestern Mutual Life Insurance Co., Siebert Lutheran Foundation, and Wisconsin Electric Power.

Of the five evaluations of the PAVE program, only the 1994 report made a serious effort to determine the program's effect on student achievement.[19] The 1994 evaluation suggested that students who attended private schools for their entire school career achieved at higher levels than students who transferred from a public school into a private school participating in the PAVE program. Further, the evaluation suggested that the longer transfer students stayed in participating private schools the greater their achievement.

Unfortunately, since the data gathered depended entirely on the voluntary cooperation of parents, the findings are suspect and no conclusion can be drawn from the evaluation's results.

Indianapolis: The Educational Choice Charitable Trust

The Educational Choice Charitable Trust was established in 1991 with a $1.2 million grant from J. Patrick Rooney, Chairman and CEO of Golden Rule Insurance Company. The Trust provides educational vouchers worth half the cost of private school tuition up to a maximum of $800. Families with children who qualify for the free or reduced-price lunch program and live in the Indianapolis school district are eligible. Half the money in the program was reserved for families whose children were in private schools prior to the creation of the program.

In March 1996 the Hudson Institute issued a report by David Weinschrott and Sally Kilgore assessing the impact of the program.[20] Public school students, but not voucher students, showed a drop-off in reading, language, and math scores in sixth and eighth grade.

Weinschrott and Kilgore described their evaluation framework as "informal." It was based on a small number of voucher students enrolled in a handful of voucher schools. The analysis did not control for differences in student characteristics, test scores prior to the voucher program, or other potentially significant variables that may have influenced the findings.

The New York School Choice Program

The New York City School Choice Scholarships Foundation (SCSF) was established in 1997 with $5 million of its $7 million commitment coming from New York businesspeople. SCSF offers tuition vouchers worth up to $1,400 to students whose family income makes them eligible for the free school lunch program. Eighty-five percent of the scholarships are reserved for public school students whose test scores are below the citywide median. In its first year (1997-98), the program offered scholarships for up to 1,300 students and actually placed about 1,200 students in private schools. In 1998-99, an additional 1,000 students participated in the program. SCSF has made four-year commitments to the current participants and will add more students as funding permits.

Of parents expressing interest in the program, a randomly selected group were interviewed to determine their eligibility, while their children (except for kindergartners) were administered the Iowa Test of Basic Skills in reading and math. A lottery determined which eligible students would be offered vouchers.

In the spring of 1997, Mathematica Policy Research and Paul Peterson of the Harvard Program on Education Policy and Governance began a three-year evaluation of the performance of students entering the New York SCSF Program in 1997-98.[21] The evaluation examines two issues. (1) It compares the achievement of about 750 students who used vouchers with that of 960 students whose families sought but did not receive a scholarship. (Ten percent of the non-voucher students ultimately attended private school anyway.) (2) The evaluation also compares the achievement of 1,000 students offered a voucher, including some students that did not use one, with that of the same control group of 960 students.

A limitation of the first comparison is that although a random group of students received scholarship offers, a *non-random* group appears to be have accepted offers. According to Peterson, Myers, and Howell (PMH), families that used scholarships had higher incomes and more education than families that did not use scholarships.[22] PMH used standard statistical procedures to control for differences between voucher users and students not offered a scholarship. However, they did not provide enough information about these procedures to permit a complete evaluation of them.

The second comparison gets around the non-random nature of the group that actually used scholarships by taking advantage of the "natural experiment" resulting from the use of a random lottery to select those offered vouchers. As a result of this lottery, the background characteristics of those offered scholarships and of those not offered scholarships may be assumed to be, on average, the same. Any differences between the two groups can be attributed to the "offer" of a scholarship. This comparison, however, is somewhat difficult to interpret. Why would the offer of a scholarship be expected to make a difference to the performance of students who do not actually accept the scholarship?

In November, 1998, PMH released first-year evaluation results. They found that being offered a voucher raised performance significantly in math in second, third, and fifth grades, and in reading in fifth grade. In third grade, being offered a voucher was negatively correlated with math and reading achievement but not significantly so. The effect on achievement of actually receiving a voucher was statistically significant in math in second, fourth, and fifth grade, and in reading in fifth grade. In third grade, receiving a voucher was negatively correlated with math and reading achievement but not significantly so.

PMH increased the number of so-called significant results by using a statistical method that requires assuming vouchers can increase but not decrease student achievement.[23] The conflicting results reported in the literature on vouchers and public versus private schools make this assumption questionable. Without this assumption, only the results for fourth-grade math, fifth-grade reading, and combined fourth- and fifth-grade math are significant. In addition, the differences between the results across grade levels are hard to interpret. This suggests that the results should be treated with caution until more data are available.

Since the PMH evaluation of the New York SCSF program constructs comparison groups, it is more informative than the PGH

analysis of the two Hope Schools in Cleveland. However, as PMH acknowledge, their SCSF evaluation involved a small number of students and the impact of a much larger program could have quite different program outcomes. A number of characteristics of the schools attended by voucher students in the New York experiment might not exist in a large-scale experiment. For example, compared to the schools attended by the control group, the voucher schools had small classes and were somewhat more racially integrated. Parents perceived that voucher schools had fewer problems with safety, fighting, cheating, missing classes, being late for school, and destroying property.

The frailty of positive findings from participation in voucher programs is suggested by the ad hoc and inconsistent ways that Peterson and co-authors explained findings from New York and from Milwaukee. In their analysis of the Milwaukee Parental Choice Program, Greene, Peterson, and Du found significant achievement effects only for students who had been in the program for three or four years.[24] They hypothesized that participation in a voucher program has a cumulative effect, with positive results only appearing in the third and fourth years, after students have been socialized in their new setting. In discussing the New York program, Peterson, Myers, and Howell hypothesized that they found significant results only for fourth- and fifth-grade students because vouchers are a more potent intervention for older students. They added that smaller classes may be more potent for younger students -- an explanation at odds with the fact that students at voucher schools in the New York program attended smaller classes than students in the control group.

In discussing their first year New York results, PMH argued that the magnitudes of the positive achievement effects observed "do not differ materially from those observed in" the Tennessee class-size reduction program.[25] This comparison is problematic because of the instability of most of the SCSF findings compared with the Tennessee results. Charles Achilles, one of the Tennessee experiment principal investigators, pointed out that since the students in the SCSF evaluation are about 95 percent minority, it might be more appropriate to compare SCSF effect sizes with the effect sizes observed for Tennessee minority students.[26] When this comparison is made, the Tennessee effect sizes (between .30 and .40) are much larger and much more stable than the effect sizes reported by PMH (-.09 to .27).

The Washington (D.C.) Scholarship Fund

The Washington Scholarship Fund (WSF) was established in 1993 to provide vouchers to low-income students. Its funding comes from a variety of individuals including John Walton and Ted Forstmann and foundations such as the Lynde and Harry Bradley Foundation. In the fall of 1997, 460 WSF participants were attending 72 private schools. Beginning with the 1998-99 school year, the program planned to offer vouchers worth up to $2,200 to more than 1,000 students in grades K-8. No family with an income higher than 2.5 times the poverty level may participate. Families with incomes that fall below the poverty line are eligible for vouchers worth up to 60 percent of the cost of private school tuition.

Parents Advancing Choice in Education (Dayton, Ohio)

For the 1998-99 school year, the Parents Advancing Choice in Education (PACE) program in Dayton, Ohio, offered vouchers to 530 students previously enrolled in public schools and 250 students previously enrolled in private schools. The program pays up to 60 percent of the tuition at one of 20 private schools participating in the program, up to a maximum of $1,200. The program is funded by the Thomas B. Fordham Foundation and a consortium of Dayton community leaders.

The WSF and PACE programs are being evaluated by the Harvard Program on Education Policy and Governance, the Northern Illinois University Social Science Research Unit, and (for the PACE program only) the University of Dayton.[27] In each program, a randomized design similar to that used to evaluate the New York School Choice Scholarship program is being implemented. At this point, no achievement data are available for either program.

San Antonio Private Voucher Programs

San Antonio has two private voucher programs, both of which are funded by the CEO America Foundation. The first began in 1992 and offers a voucher worth up to half the cost of tuition (to a maximum of $800) to any K-8 student eligible for free or reduced-price lunches who resides in Bexar County, Texas. Students may attend public or private schools. Godwin, Kemerer, and Martinez compared the effects of public school choice and private voucher programs in San Antonio.[28] The small number of students (85) for whom baseline (1991-92) and final-year (1995-96) test score data were available and the limited nature of the results make their achievement findings of little value.

In April 1998 the CEO America Foundation and James Leininger committed $50 million over a period of 10 years to launch the Horizon Program. It is the first private voucher program in the country to offer a voucher to every low-income student within a single school district (the Edgewood Independent School District in San Antonio, Texas). Any K-12 student who is eligible for a free or reduced-price lunch and who resides in the district may participate. Vouchers may pay up to 100 percent of a participating school's tuition, to a maximum of $3,600 (grades K-8) for schools in the district and a maximum of $2,000 (grades K-8) for schools outside the district. For grades 9-12 the program pays up to $4,000 for schools in the district and up to $3,500 for schools outside the district.[29]

The evaluation of the Horizon Program is to be conducted by David Myers (Mathematica Policy Research), Paul Peterson (Harvard University), Jay Greene (University of Texas), and Rodolfo de la Garza (Thomas Rivera Policy Institute). Beginning with the 1998-99 school year, the evaluation will compare the Edgewood School District to three similar school districts on a number of dimensions including student achievement. The first evaluation is due to be issued in 1999. When this report went to press, no detailed information on the evaluation design was available.

Vouchers and Educational Equity

The gap in funding between affluent and low-income districts in Pennsylvania already exceeds that in most other states. As of 1991-92, the last year for which comparable data have been collected for all 50 states, Pennsylvania had the 11th-largest gap in state and local funding per pupil between high-income and poor districts.[30] A major concern with vouchers is that they could further increase funding inequities and the stratification of students by income, race, and social background.

Vouchers could increase inequity by diverting money from students currently served by the public schools to students who already go to private schools. For example, rather than providing Milwaukee Public School children with choice, the expansion of the Milwaukee voucher and charter school programs appears to be diverting money from children in the public schools and subsidizing families who were already sending their children to private schools. According to Henry Levin (Stanford University), the 5,902 students enrolled in either charter or voucher schools cost the Milwaukee Public Schools $29,214,900 in revenue in 1997-98. Of the 5,902 voucher and charter school students, only 1,379 had attended the Milwaukee Public Schools the previous year.[31]

Levin estimated that a national voucher program that included all current private school students and that offered the full range of services provided by public schools would cost $33 billion annually. The costs of accommodating additional students in private schools, record-keeping and monitoring, and providing transportation would add another $40 billion, bringing the total to $73 billion, about 25 percent of the current cost of public education nationally.

New evidence from Arizona corroborates the fear that a large-scale school choice program may increase stratification in the schools based on income, race, and ethnicity. Casey D. Cobb and Gene V. Glass found that Arizona charter schools are increasing racial segregation in public education. Minority students are disproportionately enrolled in charter schools with non-college-preparatory curricula.[32] Large-scale voucher programs would share many of the characteristics of Arizona's largely unregulated charter school program and may, therefore, similarly reduce educational equity.

There is evidence that all school choice programs, public school choice as well as voucher and charter school programs, increase student stratification by income and other family background characteristics but do not necessarily produce academic gains.

Godwin, Kemerer, and Martinez, in their analysis of the characteristics of families that chose to participate in either public or private school choice programs in San Antonio, found significant differences between choosing and non-choosing families. Choosing families had more education, higher incomes, higher employment levels, and fewer children, and were less likely to be on welfare, less likely to be African-American, and more likely to be two-parent families. Choosing families also had higher educational expectations and were more active in their children's education. In addition, their children had higher standardized test scores.[33]

A 1992 Carnegie Foundation report evaluated choice programs around the country and reached the following conclusions. (1) To the extent that choice programs benefit children at all, they benefit the children of better educated parents. (2) Choice programs require additional money to operate. (3) Choice programs have the potential to widen the gap between rich and poor school districts. (4) School choice does not necessarily improve student achievement.[34] Bruce Fuller, in a 1995 review, drew conclusions similar to those of the Carnegie report.[35]

In a review of the research on school choice in three countries (the U.S., Great Britain, and New Zealand), Geoff Whitty found little evidence to support the contention that the creation of educational "markets" increases student achievement. He did, however, find that educational "markets" make existing inequalities in the provision of education worse.[36] Martin Carnoy drew a similar conclusion based on an analysis of the effects of school privatization in Chile and other countries.[37]

The political figure most closely identified with the contemporary voucher movement, Wisconsin state legislator Polly Williams, now expresses concerns about the political pressure to create voucher programs that would increase educational inequity. She told the *Boston Globe* in October 1998:

> I knew from the beginning that white Republicans and rich, right-wing foundations that praised me and used me to validate their agenda would do it only so long as it suited their needs. . . . This is why most black groups like the NAACP are against vouchers because without the income cap, choice just becomes a free-market program that keeps richer families happy and Catholic and Lutheran schools solvent with state money without any commitment to improve public schools. . . . Too many people in the voucher crowd exploit low-income black children, saying we are creating vouchers for them when what they really have in mind is bringing in a Trojan horse. . . . I've never seen a situation where low-income people, when they have to compete in education with people with far more resources, come out equal.[38]

KEYSTONE RESEARCH CENTER

SMALLER CLASSES: A RESEARCH UPDATE

The Recent History of Class-Size Research

The current interest in class-size research can be traced to an influential and controversial 1978 meta-analysis of class size studies from more than a dozen countries by Professor Gene Glass of Arizona State University and Mary Lee Smith.[39] Glass and Smith concluded that small classes produce higher levels of student achievement than large classes. For example, they found that being taught in a one-on-one tutorial as opposed to a 40-student class improved student performance by 30 percentile ranks. Glass and Smith argued that to be most effective classes should have about 15 students.

Robinson and Wittebols criticized the Glass and Smith study for drawing conclusions from too few studies and relying too heavily on research on individual tutoring.[40] Professor Robert Slavin of Johns Hopkins University also considered Glass and Smith's analysis flawed because it did not adequately take into account qualitative distinctions between studies.[41] In Slavin's view, except for studies of class sizes of one, Glass and Smith's evidence that class-size reductions raised achievement was weak.

The Tennessee Student-Teacher Achievement Ratio (STAR) Study

Against this backdrop of controversy over the relationship between class size and student achievement, Tennessee launched the STAR program in the mid-1980s. Key Tennessee legislators knew of an Indiana class-size program and a class-size study conducted in Nashville.[42] They were particularly influenced by Glass and Smith's meta-analysis, which suggested reducing class size to about 15. Mindful of the cost of reducing class size, the legislature wanted to study the impact of reducing class size in the early grades before adopting a class-size reduction policy.

In 1985, the Tennessee legislature passed, and Governor Lamar Alexander signed into law, funding for a statewide class-size experiment. The STAR study followed a group of students from kindergarten through third grade. Since Tennessee did not require kindergarten, many STAR students entered the study as first-graders. The STAR study began in the fall of 1985 in 79 schools within 42 school districts throughout the state.

Researchers classified schools as: (1) inner-city (metropolitan-area schools in which more than half the students received free or reduced-price lunches), (2) urban, (3) suburban, and (4) rural.

Within each participating school, the state Department of Education randomly assigned teachers and students to one of three types of classes: small (S) classes (typically 13-17 students), regular (R) classes (typically 22-25 students), and regular classes with a full-time instructional aide (RA) (typically 22-25 students).

To ensure that curriculum differences, leadership style, school climate, and other school-specific factors did not influence the results, all schools participating in the project had to be large enough to have all three types of classes at all four grade levels. The STAR project also required that there be no changes in participating schools other than the establishment of the three types of classes.

STAR is one of the few truly scientific experiments ever conducted in education. It is also a large study that involved about 6,500 students each year. In all, 11,600 different students participated in Project STAR, of whom 1,842 remained in the same type of class for all four years and 2,571 remained in the same type of class for grades 1-3.

Students in STAR were tested in reading and math on the Stanford Achievement Test and the Tennessee Basic Skills First test. STAR researchers compared improvements in achievement each year by each class type. They also compared the performance of students in small classes for three consecutive years with the performance of students in each type of regular class for three consecutive years.

STAR researchers found that students in small classes outperformed students in both R and RA classes across the board in all geographical areas and at all grade levels. Regular classrooms with a teacher's aide showed a slight but not statistically significant achievement advantage over regular classrooms in first grade. Jayne Boyd-Zaharias and Helen Pate-Bain reported in 1998 that their analysis of STAR data found no achievement advantage for classes of 25 students with a full-time teacher's aide compared to classes of 25 without an aide. This was true in grades K-3 and in a follow-up study of students in grades 4-8.[43]

Averaged over four years, students in small classes had an advantage of a bit more than eight percentile ranks over students in regular classes in reading and a bit less than eight percentile ranks in math. The effect size in reading averaged over four years was about 0.26. In math it was 0.23.[44]

In a May 1997 reexamination of the STAR data, economist Alan Krueger of Princeton University confirmed the original findings of the STAR investigators.[45] Krueger controlled for other measured factors that might influence performance, including student characteristics (race, gender, eligibility for free lunch, whether the student was new to the school, etc.) and teacher characteristics (race, gender, experience, and educational qualifications). Because students and teachers were initially placed at random into the three types of classes, these characteristics would not be expected to influence the impact of class size on performance. As anticipated, Krueger found that controlling for these variables has very little effect. He still found overall effect sizes that range from 0.19 to 0.28 in each of the four years, similar to the range reported in the original STAR analysis.[46]

The original STAR results may be understated because some classes labeled as small were actually larger than some labeled as large. (Since the number of students in a grade does not fall into multiples of 13-17 and 22-25, it is unavoidable that small and regular classes be distributed around these targets.) A research team headed by Professor Barbara Nye and B. DeWayne Fulton (Tennessee State University) re-estimated the performance difference of small classes and regular classes after removing all small classes that did not have 12-14 students and all regular classes that did not have at least 23 students from the sample. They reported effect-size advantages for small classes that average 0.56 for reading and 0.47 for math.[47]

The STAR study also found that small classes especially raised achievement in inner-city Tennessee classrooms with large concentrations of minority students.[48] Jeremy Finn and Charles Achilles concluded in a recent review paper that "in most comparisons, the benefit to minority students is about *two to three times as large as that for whites.*"[49] Krueger also found that lower achieving, minority, and poor students benefit the most from attending smaller classes.[50]

Charles Achilles, Jeremy Finn, and Helen Bain reported that when both white and non-white Tennessee students began kindergarten in small classes, 87 percent of white and 86 percent of non-white first graders passed the Basic Skills First reading test. For students who began kindergarten in regular classes, the non-white first grade pass rate trailed the white pass rate by 12 percentage points.[51]

In a review of the research literature on the white-black test gap and on class size, including the Tennessee experience, Steven Bingham concluded that small class size in the early grades is an effective achievement gap-reduction strategy. He maintained that minority children should be placed in small classes early (preferably in kindergarten) and remain in a small class for at least two years.[52]

The STAR study found that small classes increased promotion rates from each grade. Over the four years of the study, 80.2 percent of students in small classes moved up to the next grade the following year, compared with 72.6 percent of students in regular classes. Raising promotion rates for each grade saves money by reducing the number of students taught twice at each grade level.[53]

In addition, when more students are held back, the R and RA classes at the next grade level end up with fewer low-scoring students. If students in R and RA classes had been promoted at the same rate as those in small classes, the relative test scores of R and RA classes might have been even lower. The higher retention-in-grade rates of R and RA classes may cause the estimate of the additional benefit of several years in a small class to be understated.

Finally, the Tennessee experiment provides some evidence that small classes mitigate the negative effect of large schools documented by William Fowler and Herbert Walberg (University of Illinois at Chicago).[54] According to Achilles, students in regular classes achieved less well in large schools than small schools. Students in small classes did as well or nearly as well in large schools as in small schools.[55]

Because of the STAR study's size and careful design, Harvard Professor Frederick Mosteller, in a report to the American Academy of Arts and Sciences, characterized the study as "one of the great experiments in education in United States history."[56] Nevertheless, debate about the policy implications of the STAR results continues.

Are the Benefits of Smaller Classes Cumulative and Do the Benefits Last?

Recent debate about the Tennessee STAR experiment centers on two questions that turn out to be related. (1) Are the benefits of smaller classes cumulative? (2) Do the benefits last?

Initial research on the STAR experiment indicated that most of the gain appeared the first year children attended a smaller class, with the achievement gap between small and regular classes holding steady but not increasing in subsequent years. Based on this understanding, Eric Hanushek argued in a February 1998 paper that the Tennessee results support, at most, movement toward small kindergarten and first-grade classes.[57]

Contrary to Hanushek's conclusion, an increasing body of research indicates that achievement benefits do increase with additional years in small classes. Krueger found that while the achievement of students in small classes jumped by about four percentile ranks in the first year a student attended a small class, it improved by almost an additional percentile rank for each additional year. The initial effect was highly significant and the incremental improvement in subsequent years was on the margin of statistical significance.[58]

Additional new research on STAR students relies on a data base constructed for the Lasting Benefits Study (LBS), an analysis of the achievement of small- and regular-class STAR students in higher grades. A STAR student is defined in the LBS as any student who spent at least third grade in a STAR classroom.[59]

Through eighth grade, the original LBS studies found that students in small classes during part or all of K-3 continued to outperform graduates of R and RA classes by statistically significant amounts.[60] The achievement advantage for minority students who participated in small classes remained larger than that for white students.[61] Lasting benefits from small K-3 classes were found in a wide spectrum of subjects, including reading, language, math, study skills, science, and social studies.[62]

The Lasting Benefits Study showed eighth-grade effect sizes of 0.04 to 0.08,[63] seventh-grade effect sizes that ranged from 0.08 to 0.16,[64] sixth grade effect sizes of 0.14 to 0.26,[65] fifth grade results ranging from 0.17 to 0.34,[66] and fourth grade effect sizes of 0.11 to 0.16.[67] STAR students from small classes continue to outperform students in regular classes but the presence of a teacher's aide continued to have very little, if any, impact on achievement.

The new research using the LBS data base separately examined children who attended small classes for one, two, three, or four years. Barbara Nye, Larry V. Hedges and Spyros Konstantopoulos (NHK) found that statistically significant benefits from small classes persisted to eighth grade only for students who spent at least two grades in a small class. On eighth-grade math, reading, and science tests, the effect size for students who attended small classes for four years was 0.3 to 0.37, similar to the effect size for these students in grades four and six. By eighth grade, the achievement benefit of spending four years in small classes equaled four or more times that of spending one year in a small class, 80 percent more than that of spending two years in small classes, and 20 to 30 percent more than that of spending three years in small classes. In other words, the incremental benefit of each additional year in small classes appears to be roughly the same.[68]

David Grissmer of RAND pointed out that NHK's findings imply a bigger benefit from the third and fourth years of small classes than Krueger's estimates (which are described in the third paragraph of this section).[69] Grissmer hypothesized that this may partly reflect differences between the NHK and Krueger samples. Since NHK used the Lasting Benefits Study (LBS) data base, all the students in their sample took the third-grade test. Many of the students in their sample with one and two years in small classes entered small classes in second and third grade. In the full STAR sample that Krueger used, a high proportion of the students in small classes for one and two years entered and reported test scores in kindergarten and first grade. In different ways, then, both the Krueger and NHK results underscore the value of small classes in kindergarten and first grade. They also point to the benefits of additional years in small classes, with the NHK results raising questions about the durability of the "jump" in achievement after one year if it is not consolidated by additional years in small classes.

Finn and Achilles added another dimension to the literature on the lasting benefits of small classes by converting the achievement difference between small and regular class students into "grade equivalents."[70] The effect sizes normally used to measure the achievement benefit of small classes divide the average test score difference in a grade by the variability (or standard deviation) of that test score. Student performance, however, varies more in higher grades, increasing the denominator in effect-size measurements.

Grade equivalents (GEs) offer another way of looking at the impact of smaller classes. The grade equivalent of a test score is the grade level for which that score was the median score.[71] For example, if the median test score of students with four months of fourth grade was 100, the grade-equivalent of a score of 100 would be third grade plus four months. Using grade equivalents, a difference in average test scores between small and regular classes can be converted into a difference measured in grade-equivalent months of schooling. Table 3 converts the benefits from small K-3 classes into GE months of schooling. Table 4 does the same for the benefits of attending four years in small classes.

Based on their GE analysis, Finn and Achilles concluded that the achievement effect of being in a small class continues and generally increases from grade to grade.[72]

In September 1997, Health and Education Research Operative Services (HEROS), Inc., published a study of the extent to which 10th-grade students who had been enrolled in STAR small K-3 classes retained an achieve ment advantage over students who had been in regular classes and regular classes with a teacher's aide.[73] The study analyzed the relative performance of these students on the Tennessee Competency Test. It found that the performance of students who had attended small classes was not significantly better than that of students who had been in regular classes. However, the researchers did find that significantly more of the former small-class students than regular-class students had passed the test by eighth grade.

Table 3.
The Tennessee K-3 Small-Class Advantage Measured in Grade Equivalent Months of Schooling

	Kindergarten	*Grade 1*	*Grade 2*	*Grade 3*
Mathematics	1.6 months	2.8 months	3.3 months	2.8 months
Reading	0.5 months	1.2 months	3.9 months	4.6 months
Word Study Skills	0.5 months	0.8 months	4.7 months	5.7 months

Source: Jeremy D. Finn, Susan B. Gerber, Charles M. Achilles, and Jayne Boyd-Zaharias, "Short and Long-term Effects of Small Classes," paper prepared for conference on the Economics of School Reform, May 23-26, 1999, available from finn@acsu.buffalo.edu.

Table 4.
The Achievement Benefits in Grades 4, 6 and 8 of Having Spent Four Years in Small K-3 Classes, Measured in Grade Equivalent Months of Schooling

	Grade 4	*Grade 6*	*Grade 8*
Mathematics	5.9 months	8.4 months	1 year, 1 month
Reading	9.1 months	9.2 months	1 year, 2 months
Science	7.6 months	6.7 months	1 year, 1 month

Source: same as Table 2.

STAR students who graduated on schedule would have completed high school in spring 1998. In April 1999, Alan Krueger and Diane Whitmore reported preliminary results of an analysis of the rate at which a sample of 9,397 STAR study participants took college-entrance exams (the ACT and SAT tests) as seniors.[34] Overall, 43.7 percent of students assigned to a small class in their first Project STAR year took the ACT or SAT exam, compared to 40 percent of students in regular classes and 39.9 percent of students in regular classes with an aide. These differences between S-class students and R- and RA-class students were statistically significant at the 0.05 level.

Attending small classes raised the proportion of black students who took a college entrance exam by substantially more: 40.2 percent of black students in small classes took either the ACT or SAT, compared to 31.7 percent of students in regular classes. Attending a small class reduced the black-white gap in college-entrance test-taking by 54 percent.

Students initially assigned to a class with 21-25 students were more likely to take the ACT or SAT exam than students who were assigned to classes with 26-30 students. They were less likely to take one of the exams than students initially assigned to classes with 16-20 students.

Even though significantly higher proportions of small-class students took the college-entrance exams, their average scores were virtually the same as those of students in regular-size classes. The same held true for the subgroups examined.

Preliminary findings from another ongoing study, based on the high school experiences of more than 3,000 former STAR participants, showed that 72 percent of small-class participants graduated from high school on schedule compared to 66 percent of regular-class students and 65 percent of students from regular classes with a teacher's aide. While 23 percent of regular-class students and 26 percent of regular-class-with-aide students dropped out, only 19 percent of small-class students dropped out.[75]

Future research on the STAR students by HEROS, Inc., will focus on experience in higher education and on social outcomes such as juvenile detention, adult imprisonment, welfare, and employment experience.

Project Challenge

Beginning in 1989, Tennessee followed up its STAR experiment by establishing Project Challenge, which provided the money necessary to reduce K-3 class size in 16 of the state's poorest school districts. These districts typically placed low on achievement rankings of Tennessee's 138 school districts. After the implementation of Project Challenge, student achievement in math and reading improved both in comparison to the performance of previous students in these districts and in relation to other schools in the state.[76] Between 1989-90 and 1993-94, Project Challenge school districts' average ranking on grade-two test results improved from 97th-highest to 78th-highest in reading and from 90th-highest to 56th-highest in math. Therefore, student achievement in these poor districts in 1993-94 was only a little below that of the median district in the state in reading and above the median in math.

Key Findings from Analyses of the Tennessee STAR Experiment

1. On every achievement measure in every year through eighth grade, there were statistically significant differences between the performance of students in small classes and those in the two types of regular classes.

2. Every type of district -- inner-city, urban, suburban, and rural -- enjoyed significant gains from small classes.

3. In each grade, minorities and students attending inner-city schools enjoyed greater small-class advantages than whites on some or all measures.

4. The same benefits from small classes were found for boys and girls alike.

5. Rural small classes achieved the highest test scores.

6. For students who spent all four years (K-3) in small classes, the average achievement advantage on math, reading, and science tests grows from 6-9 months of schooling in grade four to more than one year of schooling in grade eight.

7. Students who attended small classes took college-entrance exams at significantly higher rates than students who attended the two types of regular classes.

8. Students who attended small classes graduated from high school on schedule at significantly higher rates than students who attended the two types of regular classes.

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Wisconsin: Student Achievement Guarantee in Education (SAGE)

Wisconsin implemented its statewide Student Achievement Guarantee in Education (SAGE) program in 1996-97. SAGE seeks to increase the academic achievement of children living in poverty by reducing the student-teacher ratio in kindergarten through third grade to 15:1.[77] Participation in SAGE requires a school to implement a rigorous academic curriculum, provide before- and after-school activities for students and community members, and implement professional development and accountability plans.

All districts with a school that enrolls 50 percent or more low-income children participated. Within these districts, any school enrolling 30 percent or more low-income children could apply. Each eligible district except Milwaukee could designate one school as a SAGE school. Milwaukee was allowed 10 SAGE schools.

Schools entering the program had to agree to remain in SAGE for its five-year duration. They also had to submit an annual "Achievement Guarantee Contract" to the state Department of Public Instruction. This contract explains how the school plans to implement the SAGE program requirements. Schools are allowed wide latitude in developing their plans. Upon accepting a school into SAGE, the state provides up to an additional $2,000 per low-income student enrolled in SAGE classrooms. The original legislation specified that no new schools would be admitted after the start of the 1996-97 school year. However, SAGE proved so popular that the state legislature agreed to expand it beginning with the 1998-99 school year.

SAGE is designed to be implemented in stages. Kindergarten and first-grade classes entered the program in 1996-97, second grade was added in 1997-98, and third grade in 1998-99. All classrooms at the appropriate grade level in participating schools must have a student-teacher ratio of no more than 15:1. During the 1996-97 school year, SAGE was implemented in 30 schools in 21 school districts throughout Wisconsin.

The legislation creating SAGE requires an annual evaluation of the program and a fifth-year final report on the impact of the program on academic achievement. Alex Molnar and co-researchers at the School of Education at the University of Wisconsin-Milwaukee are conducting this legislatively mandated evaluation.[78] SAGE schools are being compared to a group of 14-17 non-SAGE schools (the exact number depending on the year) in SAGE districts. Students are tested in reading, language arts, and math on the Comprehensive Test of Basic Skills (CTBS) Complete Battery, Terra Nova edition.

Comparison schools were selected for their similarity to one or more individual SAGE schools in demographic composition, school size, initial third-grade test scores, and percentage of low-income students. In addition to quantitative analysis, the SAGE research plan contains extensive qualitative research, including interviews of teachers and principals, surveys of teachers, examination of teacher logs, and classroom observation.

Why Are Small Classes So Effective?

The STAR, SAGE, and other studies reviewed in this report suggest that small classes promote higher achievement for several mutually reinforcing reasons.

- Children receive more individualized instruction: one-on-one help, small-group help, class participation.
- Children misbehave less because of the family atmosphere and quick intervention by teachers.
- Teachers spend more time on direct instruction and less on classroom management.
- Classes include more "hands-on" activities although most instruction remains teacher - not student - centered.
- Students become more actively engaged in learning than peers in large classes.
- Teachers of small classes "burn out" less often.

The SAGE evaluation established a baseline measure of performance for partici pating students by testing first-graders in the fall and the spring (beginning in 1996-97). Second-graders (beginning in 1997-98) and third-graders (beginning in 1998-99) are tested in the spring. The SAGE evaluation will track through third grade students who were first graders in the program in 1996-97, 1997-98, and 1998-99. In any given first-grade year, the number of SAGE students with valid test scores (1300) is somewhat smaller than in Tennessee's STAR experiment. The control group of 850 students is substantially smaller than the combined regular-class and regular-class-with-aide groups in STAR (4,000 students). However, over the three first-grade classes as a whole, the SAGE small-classes group with valid test scores is expected to include about 4,000 students and the comparison group about 2,500.

Thus far, the SAGE evaluation has published reports for the 1996-97 school year and the 1997-98 school year. The results appear consistent with those reported for the Tennessee STAR experiment. (Precise comparisons must await parallel application of similar research methods to the two data sets.)

- In 1996-97 and again in 1997-98, students in SAGE first-grade classrooms scored significantly higher in all areas tested. The first-grade effect sizes are in the range of 0.1 to 0.3, depending on the statistical method used.
- From spring 1997 to spring 1998, second-grade SAGE students' scores increased more than those of comparison-school students but not by statistically significant amounts (at the .05 level). Over the two years taken together, SAGE second-graders showed statistically significant gains in language arts, mathematics, and total score, but not in reading.
- The achievement benefit of SAGE small classes is especially strong for African-American students. In 1997-98, for example, African-American students in SAGE classes increased their average total score by 52 points compared to 33 points for African-Americans in comparison

schools. For whites, SAGE school first-grade test scores increased by 46 points compared to 41 in comparison schools. Thus, African-American SAGE first-grade students closed the "achievement gap" with white students over the course of the school year. However, the gap widened substantially in comparison schools.

- In 1997-98, there was no significant difference between student achievement in SAGE first-grade classes with two teachers and up to 30 students and student achievement in classes with one teacher and up to 15 students. If sustained in subsequent evaluations, this finding would have considerable significance for policy and practice. By adding teachers to larger classes, school districts that lack the resources to build new classrooms could reap the benefits of small classes.

- Analyses of qualitative data suggest that teachers in SAGE classrooms have greater knowledge of each of their students, spend less time managing their classes, have more time for instruction, and use more individualized instruction.

California

In the 1996-97 school year, California appropriated almost $11 billion to implement an ambitious class-size reduction program. In the first year, districts received $650 for each student enrolled in a class of no more than 20 students. The 1997 California budget raised the allotment to $800 per student and contained an additional $1.5 billion for class-size reduction. Schools must start by reducing class size in first grade, then in second grade, and then in either kindergarten or third grade. The program's popularity is illustrated by the fact that, by February 1997, 92 percent of all first graders and 74 percent of all second graders were attending small classes. By 1997-98, 873 of 895 eligible school districts were receiving aid under the program and 18,400 new classes had been added.[79]

Randy Ross, a social scientist working for school reform in Los Angeles, sharply criticized the California program for doing too much, too fast.[80] By implementing class-size reduction across the board, he claimed, the state exacerbated an existing teacher shortage. California's Legislative Analyst Office made a similar criticism:

> The CSR [class size reduction] program result[ed] in the hiring of about 18,400 teachers [in 1996-97] . . . in addition to the approximately 16,000 elementary teachers that will be hired for normal replacement. . . . Twenty-four percent of teachers hired for CSR are not credentialed and are working under an emergency permit or waiver. School districts rate teachers hired for CSR as being less skilled, on average, than teachers hired in previous years. At the same time districts are hiring less qualified teachers, most are also experiencing difficulties in implementing staff development for those teachers.[81]

With statewide class-size reduction, the best and most qualified teachers had their choice of districts in which to work. As some of these teachers abandoned inner-city schools, these schools hired more teachers

without credentials. In Los Angeles, two-thirds of new teachers hired were without credentials.[82]

The California legislature appropriated $1.75 million for a three-year study of the impact of the class-size reduction program. The research will be conducted by a consortium of research organizations (WestEd, PACE, American Institutes for Research, RAND, and EdSource). The aim is to encour age information-sharing and learning by practitioners as well as to add to the research literature. The research design will focus on successive cohorts of third- and fourth-graders who have and have not attended smaller classes.

Press reports based on test data compiled by the California Department of Education indicate that second- and third-grade students in classes of 20 or fewer were scoring above the national average in reading and math at higher rates than students in larger classes. However, these data have not been subjected to rigorous analysis.[83]

CONCLUSION

There is no longer any argument about whether reducing class size in the primary grades increases student achievement. The research evidence is quite clear: it does.

Policymakers considering education reforms to improve the achievement of low-income children should carefully consider the strength of the evidence and the quality of the research on smaller classes. In policymaking, there is sometimes a tendency to regard all studies and research reports as being created equal. They are not. As Princeton University economist Alan Krueger put it, referring to the STAR study, "One well designed experiment should trump a phalanx of poorly controlled, imprecise observational studies based on uncertain statistical specifications."[84]

In contrast, the claim that participation in a voucher program increases student achievement remains weak. The most carefully analyzed voucher program, the Milwaukee Parental Choice Program, included a small number of students, many of whom left the program each year. Although two out of three analyses found positive achievement advantages in math (but not in reading) for voucher students, these results were derived by applying complex and sometimes controversial analytic methods to weak data. As Cecilia Rouse, the most sophisticated researcher to analyze the Milwaukee data, pointed out, data limitations threaten the validity of any evaluation of the Milwaukee voucher program. Statistical techniques cannot substitute for better data.[85]

Similar problems bedevil the evaluation of the Cleveland voucher program. The official evaluation of Cleveland found no significant differences between voucher and public school students in one year and gains for voucher students in only one subject, language arts, in a second year. Reminiscent of the Milwaukee evaluation debates, a team of researchers led by Paul Peterson of Harvard reexamined the official data, made two controversial methodological assumptions, and pronounced the Cleveland voucher program a success.

Faced with the ambiguity of the existing evidence, some may argue that we need more voucher experiments. This is one of the arguments being used to justify the expansion of the private voucher programs described in this report. More reliable data may emerge in the next several years from some of these programs.

The problem with research on small-scale voucher experiments, however, is not only the lack of clear performance effects. More fundamentally, the problem is that such small-scale programs — no matter how crystal clear their achievement consequences — can tell us little about larger-scale programs. Voucher evaluations are less informative than class-size research because "vouchers" do not represent a specific educational reform. If a voucher program generates positive effects, the research does not generally look inside the schools to ask what explains the success. It simply assumes that private is better.

A second reason that voucher research tells education policymakers little relates to the issue of scale. As research on private schools shows, some private schools appear to raise achievement through "peer effects" — by placing low-income students with other

students from more privileged families who place a high priority on education. (Elite private schools also tend to spend large amounts of money per student and to have smaller classes.) But in a large-scale voucher program, peer effects could be quite different than in a small-scale program. This may help explain why new schools that enroll voucher students in Cleveland perform less well than public schools while established private schools perform better than public schools.

For these reasons, the only way to find out the impact of a large-scale voucher program is to implement one. However, there is no strong evidence that this would improve achievement. In addition, such a large-scale program would likely raise spending on students who already attend private schools and reduce educational spending on children currently in public school.

IMPLICATIONS FOR PENNSYLVANIA

As the Tennessee and now the Wisconsin class-size research results have become more widely known, reducing class size has become a favorite of state and federal legislators, as well as parents, across the country. In California, small classes have been introduced so rapidly and on so large a scale that the achievement benefits and the cost-effectiveness of reform may be reduced. California's class-size reduction has exacerbated teacher shortages and meant that one quarter of teachers hired to lower class sizes have only emergency credentials. Low-income areas may also have lost experienced teachers as class-size reduction created openings in more affluent areas.

Pennsylvania has a rare opportunity to introduce a class-size reduction program targeted on the areas in which it would generate the greatest benefits and designed in a way that would generate knowledge of how to improve educational achievement in a cost-effective manner. Such a **SMART (Scientific Methods, Achieving Results Today) class-size** program should begin by reducing class size in kindergarten and first grade. As in Wisconsin, priority should be placed on lowering class size in schools that serve high proportions of low-income students. Selective introduction of small K-1 classes in the rest of the state would permit additional scientific analysis of the benefits of small classes.

Pennsylvania should also take a scientific approach to evaluating the additional benefits of small classes in second and third grade. Building on Wisconsin's experience, Pennsylvania should evaluate the benefits of combining class-size reductions with other (e.g., curricular and teacher training) innovations.

As SMART class-size program students progress through higher grades, Pennsylvania should track social indicators of well-being as well as achievement test scores. In Wisconsin, the initial interest in smaller classes stemmed from their potential social as well as achievement benefits. A statewide Urban Initiative task force (which included bipartisan legislative and business leaders) believed that smaller K-3 classes might reduce youth violence by increasing the chance that children entering school will find an adult who knows and cares for them.

The Tennessee STAR experiment represents not just a shining example of scientific educational research but also an inspiring illustration of politics at its best. The demonstration resulted from a compromise between legislators who wanted widespread class-size reductions and those who considered them too expensive given the quality of the evidence on their benefits.

Pennsylvania now has a chance to achieve a similarly historic advance. It can invest in high-payoff class-size reduction for low-income students while conducting systematic analysis of what additional investments would make sense. A dozen years from now, such a program could win for Pennsylvania the kind of recognition now accorded the Tennessee STAR experiment.

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[47] Jayne Boyd-Zaharias et al., "Quality Schools Build On A Quality Start," in *Creating the Quality School*, ed. Edward W. Chance (Madison, WI: Magna Publications, 1995). In regression analysis, Alan Krueger also considered the impact of using actual class size rather than the original designations into small and regular classes. As in the Boyd-Zaharias study, having a class-size difference of more than 10 generates a significantly larger effect size than when considering the originally designated small and regular classes as a group. Krueger, "Experimental Estimates of Education Production Functions."

[48] Word et al., *Student/Teacher Achievement Ratio (STAR)*. These findings are also reported in Jeremy D. Finn et al., "Three Years In A Small Class," *Teaching and Teacher Education* 6(2) (1990): 127-136.

[49] Jeremy D. Finn and Charles M. Achilles, "Tennessee's Class Size Study: Findings, Implications, Misconceptions," *Education Evaluation and Policy Analysis*, Summer 1999 (forthcoming). Emphasis in original. See also Jeremy D. Finn and Charles M. Achilles, "Answers and Questions About Class Size: A Statewide Experiment," *American Educational Research Journal* 27(3) (Fall 1990): 557-577.

[50] Krueger, "Experimental Estimates of Education Production Functions."

[51] Charles M. Achilles, Jeremy D. Finn, and Helen P. Bain, "Using Class Size to Reduce the Equity Gap," *Educational Leadership* 55(4) (December 1997/January 1998): 40-43.

[52] C. Steven Bingham, *White-Minority Achievement Gap Reduction and Small Class Size: A Research and Literature Review* (Nashville: Center of Excellence for Research and Policy on Basic Skills, Tennessee State University, 1993).

[53] John Folger and Carolyn Breda, "Evidence From Project STAR About Class Size and Student Achievement," *Peabody Journal of Education* 67(1) (Fall 1989): 17-33.

[54] Cf. J. Fowler, Jr., and J. Walberg, "School Size, Characteristics and Outcomes," *Educational Evaluation and Policy Analysis* 13(2) (Summer 1991): 189-202.

[55] C.M. Achilles, *Summary of Recent Class-Size Research With an Emphasis on Tennessee's Project STAR and Its Derivative Research Studies* (Nashville: Center of Excellence for Research and Policy on Basic Skills, no date).

[56] Frederick Mosteller, "The Tennessee Study of Class Size in the Early School Grades," *The Future of Children* 5(2) (Summer/Fall 1995): 113-127.

[57] Eric A. Hanushek, "The Evidence on Class Size," W. Allen Wallis Institute of Political Economy Occasional Paper 98-1, University of Rochester, February 1998.

[58] Krueger, "Experimental Estimates of Education Production Functions."

[59] The LBS follow-up to STAR led to the establishment of a statewide K-3 class-size reduction in 1995. Under this reduction, Tennessee provided state funding to reduce K-3 class size to 20 statewide with an option of 15 for at-risk students. These goals are expected to be achieved by the year 2001 and are already 80 percent achieved in kindergarten and grade one. The STAR and LBS projects and subsequent legislative action are excellent examples of the effective use of research and evaluation by state policymakers.

[60] In the eighth-grade technical report, about half the sample had been in small K-3 classes. About 20 percent of the sample had only one year in a small class. Barbara A. Nye, B. DeWayne Fulton, Jayne Boyd-Zaharias, and Van A. Cain, *The Lasting Benefits Study, Eighth Grade Technical Report* (Nashville: Center of Excellence for Research and Policy on Basic Skills, Tennessee State University, 1995), Table 1, p. 5.

[61] Nye, Fulton, Boyd-Zaharias, and Cain, *The Lasting Benefits Study, Eighth Grade Technical Report.* See also Barbara A. Nye, "Class Size and School Effectiveness: Answers from Longitudinal Studies," paper presented at the 11th International Congress for School Effectiveness and School Improvement, University of Manchester, U.K., January 1998.

[62] Barbara A. Nye, Jayne Boyd-Zaharias, B. DeWayne Fulton, and C.M. Achilles, *The Lasting Benefits Study, Fourth Grade Technical Report* (Nashville: Center of Excellence for Research in Basic Skills, Tennessee State University, 1991).

[63] Nye, Fulton, Boyd-Zaharias, and Cain, *The Lasting Benefits Study, Eighth Grade Technical Report,* Tables 5 and 7.

[64] Nye, "Class Size and School Effectiveness."

[65] Barbara A. Nye, Jayne Boyd-Zaharias, B. DeWayne Fulton, and C.M. Achilles, *The Lasting Benefits Study: Seventh Grade Technical Report* (Nashville: Center of Excellence for Research in Basic Skills, Tennessee State University, 1994).

[66] Barbara A. Nye, Jayne Boyd-Zaharias, B. DeWayne Fulton, and C.M. Achilles, *The Lasting Benefits Study, Sixth Grade Technical Report* (Nashville: Center of Excellence for Research in Basic Skills, Tennessee State University, 1993).

[67] Barbara A. Nye, B. DeWayne Fulton, and Jayne Boyd-Zaharias, *The Lasting Benefits Study, Fifth Grade Technical Report* (Nashville: Center of Excellence for Research in Basic Skills, Tennessee State University, 1992.)

[68] Barbara Nye, Larry V. Hedges, and Spyros Konstantopoulos, "The Long Term Effects of Small Classes: A Five Year Followup of the Tennessee Class Size Experiment," *Educational Evaluation and Policy Analysis*, Summer 1999 (forthcoming), especially Table 5. The authors caution that the assignment of students to the groups that received one, two, three, and four years of small classes was not random because students' moves into and out of STAR classrooms were controlled by parents' decisions about moving. If students who moved into or out of STAR classrooms during the experiement differed systematically from students who remained in these classrooms the entire time, this could distort the results.

[69] See the David W. Grissmer essay in *Educational Evaluation and Policy Analysis*, Summer 1999 (forthcoming).

[70] Jeremy D. Finn and Charles M. Achilles, "Tennessee's Class Size Study: Findings, Implications, Misconceptions," *Educational Evaluation and Policy Analysis* (Summer 1999, forthcoming).

[71] Finn and Achilles, "Tennessee's Class Size Study."

[72] Finn and Achilles, "Tennessee's Class Size Study."

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[73] Helen Pate-Bain, Van A. Cain, Elizabeth Word, and M. Edward Binkley, *The Student/Teacher Ratio (STAR) Project STAR Follow-up Studies 1996-1997*, Health and Education Research Operative Services (HEROS), Inc., September 2, 1997.

[74] Alan B. Krueger and Diane M. Whitmore, "The Effects of Attending a Small Class in the Early Grades on College Attendance Plans," unpublished paper, Princeton University, April 9, 1998.

[75] Helen Pate-Bain, B. DeWayne Fulton, and Jayne Boyd-Zaharias, *Effects of Class-size Reduction in the Early Grades (K-3) on High School Performance*, Health and Education Research Operative Services (HEROS), Inc., April 1999.

[76] Barbara A. Nye, Charles M. Achilles, Jayne Boyd-Zaharias, and B. DeWayne Fulton, *Project Challenge Fifth Year Summary Report* (Nashville: Center of Excellence for Research in Basic Skills, Tennessee State University, 1995). See also the first (1991), second (1992), and third (1993) Project Challenge summary reports, and Charles M. Achilles, Barbara A. Nye, Jayne Boyd-Zaharias, and B. DeWayne Fulton, "The Lasting Benefits Study (LBS) In Grades 4 and 5 (1990-1991): A Legacy From Tennessee's Four-Year (K-3) Class-Size Study (1985-1989), Project STAR," paper presented at the North Carolina Association for Research in Education, Greensboro, NC, January 14, 1993.

[77] The term "student-teacher ratio" is used here because a number of participating schools reduced their class sizes by means other than placing one teacher with 15 students. In the SAGE program, "student-teacher ratio" is used in ways that capture the everyday understanding of "class size." For example, it is not a statistical artifact of having many certified staff members outside the classroom.

[78] Peter Maier, Alex Molnar, Stephen Percy, Philip Smith, John Zahorik, *First-year Results of the Student Achievement Guarantee in Education Program* (Milwaukee: Center for Urban Initiatives and Research, University of Wisconsin-Milwaukee, December 1997); Alex Molnar, Philip Smith, and John Zahorik, *1997-98 Evaluation Results of the Student Achievement Guarantee in Education (SAGE) Program* (Milwaukee: School of Education, University of Wisconsin-Milwaukee, December 1998). These documents are available on the SAGE Web site (http://www.uwm.edu/SOE/centers&project/sage/). See also Alex Molnar, Philip Smith, John Zahorik, Amanda Palmer, Anke Halbach, and Karen Ehrle, "Wisconsin's SAGE Class Size Reduction Program," *Educational Evaluation and Policy Analysis* (Summer 1999, forthcoming).

[79] Data for 1996-97 come from http://www.lao.ca.gov/class_size_297.html. Data for 1997-98 are from Edward Wexler et al., *California's Class Size Reduction: Implications for Equity, Practice, & Implementation*, PACE-WestEd, March 1998.

[80] Randy Ross, "The Dark Secret Behind California's Class Size Reduction Program," *Education Week*, May 17, 1999. Cited from Richard Rothstein, "Small Classes Make a Big Difference . . . Ceteris Paribus," http://epn.org/rothstei/Rothstein0599.html.

[81] http://www.lao.ca.gov/class_size_297.html.

[82] Richard Rothstein, "Small Classes Make a Big Difference . . . Ceteris Paribus," http://epn.org/rothstei/Rothstein0599.html.

[83] Ken Hoover, "State Data Hint Smaller Classes Are Effective Modest improvement noted on test scores," *San Francisco Chronicle*, December 26, 1998. See also "Smaller Calif. Classes Foster Reading and Math Gains," *Education USA*, January 11, 1999. The U.S. Department of Education's regional laboratory, WestEd, maintains a Web site with many resources related to class size reduction policy [http://www.wested.org/policy/hot_top/csr/ht_tp_csr.htm]. The Web site includes a preliminary review, by the quasi-public research organization Policy Analysis for California Education, of the state's experience with class-size reduction [http://www.wested.org/policy/pubs/full_text/class_size/main.htm].

[84] Krueger, "Experimental Estimates of Education Production Functions."

[85] Rouse, "Schools and Student Achievement."

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